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X. *Account of an extraordinary Appearance in a Mist.*  
 By Mr. William Cockin; communicated by Joseph  
 Banks, Esq. P. R. S.

Read Feb. 20, 1780.

Lancaster, Sept. 2, 1777.

JANUARY 13, 1768, betwixt nine and ten in the morning, being on an eminence that overlooked some low meadow ground, I observed, in a direction opposite to that of the sun, which shone very bright, and in a mist which covered the said inclosures, an unusual meteor, which, without attempting to name it, I shall describe as well as I can by the help of the following figure.

At about the distance of half a mile, and incurvated towards each other, like the lower ends of the common rainbow, there appeared in the mist two places of a peculiar brightness as represented at AA. They seemed (as is common) to rest upon the ground, were continued as high as the mist, and in breadth, perhaps, near half as much more as that of the iris. In the middle, between these two places, on the same horizontal line, was a coloured

loured appearance like  $dc b$ ,  $a$ ,  $bcd$ , whose base could not at most subtend an angle of above ten or twelve degrees, and whose interior parts were thus variegated. The center  $a$  was dark and irregularly terminated, as if made by the shadow of some object not bigger than an ordinary sheaf of corn. Next this center was a curved space  $bb$ , of a yellowish flame colour. To this succeeded another curved space of nearly the same dark cast as the center, seemingly tinged with a faint hue of green, and very evenly bounded on each side, as is shewn at  $cc$ . After these came on the terminating ring, which was coloured very much in the manner of the common rainbow, except that the tints were not quite so vivid (as if owing to the effect of a yellowish tinge, which seemingly entered into the composition of all the colours) nor their boundaries so well defined. The center of the image appeared to be exactly in the line of aspect (as it is called) or one conceived to be drawn from the sun through the eye of the spectator; and it may be observed from the figure, that these curve spaces were not segments of perfect circles, but formed like the ends of concentric ellipses, whose transverse axes were perpendicular to the horizon.

To the above description of the image it may be necessary to add the following particulars which attended it.

The

The mist was very thick near the surface of the meadows, though rarer upwards, and chiefly, if not solely, on the side of the hill opposite to the sun. The place where I stood was just on its confines; and I found, as I advanced into it, that the object became gradually fainter and fainter. As the sun dispersed the vapour, the appearance faded proportionably; and about half an hour after I first saw it, it was scarcely visible. The evening before was wet; but the drops on the hedges were congealed by frost. Where the sun shone the bushes were each invested with a mist, as if owing to the vapours exhaled from them by the sun's warmth; and, on a nearer inspection (for there was something singular in this appearance), I was rather surprized to find, I could clearly discern the little humid particles which occasioned it, and which were floating around the bushes at about half an inch distance from one another.

Such were the most material circumstances of this beautiful and singular appearance. Singular no doubt it is, as we have only two instances of a like kind mentioned in Dr. PRIESTLEY'S History of Light and Colours. The first is given by M. BOUGUER as seen upon the Andes<sup>(a)</sup>;

(a) This is described as seen in a cloud consisting of frozen particles, and at about thirty paces distance. All the parts of the observer were clearly shadowed out, as legs, arms, and head, about which last parts the coloured circles were formed. It is farther noted, that the intervals between the circles continued equal, though their diameters were constantly changing.

and

and the other by Dr. MACFAIT as seen in Scotland <sup>(b)</sup>. A third, however, may be met with as observed at Pambamarca <sup>(c)</sup>, in ULLOA's Voyage to South America.

It is the pleasure of philosophy to attempt something by way of solution concerning every extraordinary fact which falls under its cognizance: and though it be not always so happy as to produce satisfaction, it may at least succeed in the way of amusement. Under the influence of these notions, let us see what offers respecting the philosophy of the curious appearance before us.

With regard to the elliptical form of the curve spaces, as it cannot be accounted for from refraction, I apprehend it is owing to the oblong figure of the observer's shadow, which is very evidently the dark part in the middle, and to which the coloured marginal rings are in some sort obliged to conform. The bright places AA correspond to an appearance once observed by Dr. SMITH <sup>(d)</sup>, and which he very plausibly attributes to a confused mixture of the principal reflected beams

(b) This was seen in an extremely thick fog or mist. The interval corresponding to *bb* was observed to consist of colours similar to, though fainter than, those of *dd*.

(c) The apparent distance is here placed at about ten toises. The vapours are said to be of a tenuity cognizable by the sight. The gradual change of the diameter of the rings is mentioned; as also, that they appeared at first to be of an elliptical figure.

(d) See Art. 502. of the remarks at the end of his Optics.

that exhibit the ordinary bow. This must be owing to something peculiar in the mist, as to the form, size, &c. of its particles or globules; easier to conceive than explain. In the valuable Treatise of Optics by the last named gentleman, there is an account of Dr. PEMBERTON's theory for the slender rings of colours, which are sometimes seen within the rainbow, which Dr. LANGWITH first described in the Philosophical Transactions<sup>(e)</sup>, and from which some idea may be formed of the cause of the coloured part of the image. It is in substance this<sup>(f)</sup>. If the drops of rain, &c. which the sun shines upon be exceedingly small, from the irregular reflection of all surfaces, and the fits of easy transmission, which the dissipated rays may undergo in their passage through those little globules, there may naturally be formed other coloured arches within the common bow for a number of successions. Hence, with regard to the instance in question, since its rings were so very small in diameter, it appears, that on some account or other the refracted, coloured, and dissipated rays alluded to, have in their return to the eye nearly made the smallest angles possible with the lines of incidence.

(e) N° 375.

(f) See Articles 506, 507.

After all, this is only to be considered as conjecture. Though it does not want analogy, we have not had it yet properly ascertained by experiment: and hence it is not without reason, that Dr. PRIESTLEY considers the additional rows of colours within the common rainbow observed by Dr. LANGWITH, and those of the species of image here described, as one of the *desiderata* of optics.



